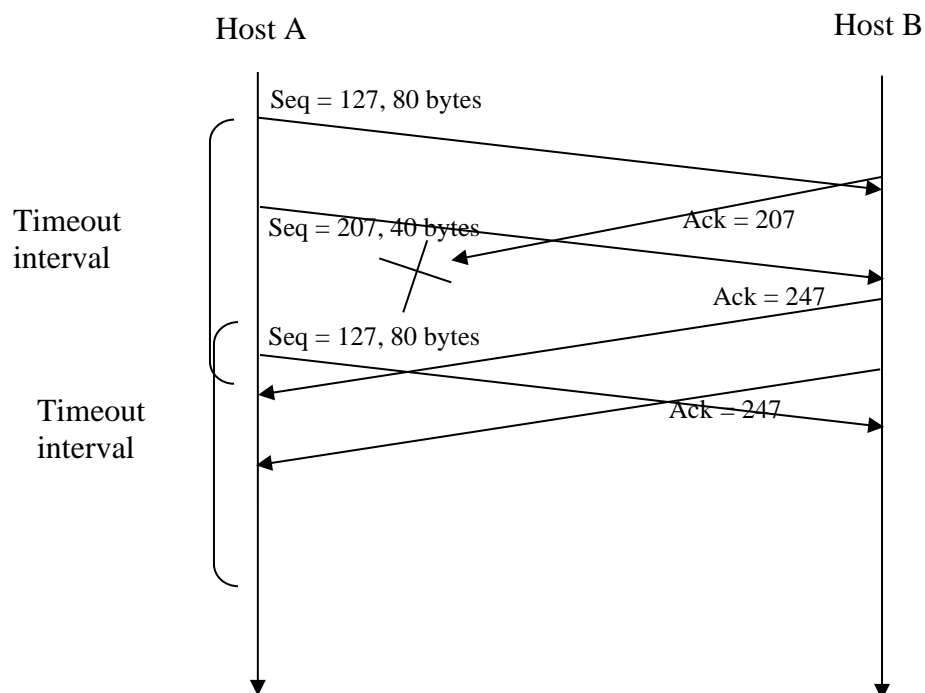


Problem 5

No, the receiver cannot be absolutely certain that no bit errors have occurred. This is because of the manner in which the checksum for the packet is calculated. If the corresponding bits (that would be added together) of two 16-bit words in the packet were 0 and 1 then even if these get flipped to 1 and 0 respectively, the sum still remains the same. Hence, the 1s complement the receiver calculates will also be the same. This means the checksum will verify even if there was transmission error.

Problem 27

- In the second segment from Host A to B, the sequence number is 207, source port number is 302 and destination port number is 80.
- If the first segment arrives before the second, in the acknowledgement of the first arriving segment, the acknowledgement number is 207, the source port number is 80 and the destination port number is 302.
- If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, the acknowledgement number is 127, indicating that it is still waiting for bytes 127 and onwards.
-



A TCP connection is established at time slot $t=0$, the MSS is equal to 1KB and $RTT=100ms$. Given that no packets are being lost, which time slot the congestion window will be equal to 16KB.

1 RTT for setup, then transitions $1 \rightarrow 2 \rightarrow 4 \rightarrow 8 \rightarrow 16$
(4RTT)
= 5 RTT = 500ms

When the congestion window becomes equal to 16KB, there is a timeout. The sender keeps sending packets. If there is no loss of packets, after how much time the congestion window will be equal to 14KB?

**After timeout, drops to 1 MSS, then does fast retransmit
to $\frac{1}{2}$ previous cwnd $1 \rightarrow 2 \rightarrow 4 \rightarrow 8$**

Then additive increase

**$8 \rightarrow 9 \rightarrow 10 \rightarrow 11 \rightarrow 12 \rightarrow 13 \rightarrow 14$
= 9 RTT = 900ms**

If the congestion window is equal to 14KB, the sender receives four acknowledgments with the same sequence number. How much time after receiving the fourth acknowledgment, the congestion window will be equal to 9KB?

Just drops by $\frac{1}{2}$ cwnd to 7MSS

Then does additive increase:

**$7 \rightarrow 8 \rightarrow 9$
= 2 RTT = 200 ms**